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## RED SANDSTONE OF CENTRAL KANSAS.

BY B. F. MUDGE.

Next above the Permian a belt of red sandstone, corresponding in appearance and (in part) in position with the new red sandstone of the older geologists, crosses the State of Kansas from the State line in Washington county in a southwesterly direction to the Indian Territory, passing out of the State near its southwestern corner. Its extent within our State is about three hundred miles, and its width in a northwesterly line varies from thirty to fifty miles. The middle and lower portion of this deposit has usually been assigned to the Triassic, but as it contains scarcely any fossils, and those not in good preservation, its true position is still uncertain. Prof. Swallow found but a single fossil, and that a doubtful *nucula*.\* Other geologists have succeeded no better in collecting or identifying the fossils of this division of the red sandstone of Kansas. The only evidence that any portion of this sandstone is older than the Cretaceous, is the fact that in northern Nebraska, under the red sandstone of the Cretaceous, is a deposit of sandstone in physical characteristics, identical with ours, in which the fossils are recognized by Meek as clearly Jurassic. As the Cretaceous is traced uninterrupted from thence to Kansas, and no unconformability is anywhere seen, it is not improbable that a portion of our territory is covered with Triassic or Jurassic rocks. Until further discoveries are made the question must be considered an open one, whether either of these formations exist in Kansas, though my opinion is they do not.

While we were in doubt concerning the age of the lower portion of this red sandstone deposit, we are not left in doubt in relation to the true position of the higher strata. Although there is no difference in the higher and lower strata, and it is even difficult to trace a single bed and identify it over an extent of twenty miles, yet the fossils of the later or higher deposits are well preserved and unmistakably Cretaceous.

The most marked and important fossils are the leaves of dicotyledonous plants. These are usually in good state of preservation, the veins and veinlets being frequently as clearly visible in all their outlines, as they lie imprinted on stone, as those just taken from living trees. These represent about a dozen different genera, the

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\* Meek, in the last report on the geology of this State and the adjoining territories, does not mention any Triassic fossils as found in Kansas.

most common of which are Liquidambar, Populus, Salix, Fagus, Quercus, Platanus, Sassafras, Liriodendron, Magnolia, and, more rarely, the Cinnamomum. These are represented by about fifty species, all extinct. In addition we find some of extinct races, as the Creducris and Dombeiospis.

These fossils are found at uncertain intervals of territory. In searching for them we have frequently examined every visible outcrop for fifteen or twenty miles without finding a specimen, then perhaps a single square mile would furnish several good localities.

Our cabinet is represented by specimens collected from twenty-five or thirty places, from Washington county to Fort Larned, near the Arkansas, a distance of one hundred and seventy-five miles. The fossil plants are usually obtained from thin layers or strata, extending in a horizontal position along a ravine or around a hill. They may occur at several places in the same vicinity, but usually without any connection. Thus in Clay county, near Riverdale, they were found at the bottom of a well, as low as the bed of the Republican, and on the top of an adjoining hill two hundred feet high, with numerous strata between, in which none could be seen.

These deposits appear to have been local, dependent upon circumstances. There must have been, necessarily, an arm of the sea or lake, with soft, sandy mud, bordered by an adjoining dry land covered with a forest. The characteristic of the local deposits indicate that the forests were on small islands sparsely scattered over the Cretaceous ocean.

While plants are thus widely scattered in this sandstone, other fossils are extremely rare. In the vicinity of Fort Harker a few fish vertebræ and sharks' teeth are found. Though we have carefully searched over a large portion of the country covered by this deposit, both in the Cretaceous and the beds called Triassic, for mollusks and the common marine fossils, we have discovered them in but one locality, and that of very limited area.\*

Three years ago, passing from Salina to Harker, when near what is now the town of Bavaria, we picked up in the road some marine fossils. Tracing the specimens to the top of an adjoining hill, we found a few acres covered with a stratum not over two feet in thickness, rich in small shells. We sent a box to Prof. Meek, of the Smithsonian Institution, for critical examination, who found twelve species new to science, a full description of which can be seen in Hayden's recent report of the United States Geological Survey of Wyoming and contiguous Territories, pages 297-313.

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\* Since the reading of this article before the Society, another locality has been found about four miles from Bavaria. They are in good preservation, differing very much from the first locality, but have not yet been critically examined.

The following is the list, which we believe includes nearly all the mollusks thus far found in the red sandstone within the bounds of Kansas:

*Crassatellina oblonga.*  
*Area (?) parallela.*  
*Yoldia microdonta.*  
*Cardium Kansensis.*  
*Cardium (Protocardia) Salinense.*  
*Cyrena (Corbicula?) nucalis.*  
*Cyrena (Corbicula?) subtrigonalis.*  
*Tellina subscitula.*  
*Tellina (?) mactroides.*  
*Leptosolen Conradi.*  
*Turritella Kansensis.*  
*Turbo Mudgeanus.*

These shells are in the same strata and in the vicinity of several deposits of the dicotyledonous leaves, and with the plants identify this portion of the sandstone as belonging to the Dakota group of the Cretaceous, as described by Meek and Hayden in their first report.

The sandstone varies in a great degree in various localities, and even in the same quarry. In color it varies from white to nearly black, but usually of a dark brown. Much of it makes an excellent building material, being durable and easily wrought.

Within the past four years the leaves have been found lower down, or nearer the Permian than they were previously known to exist. Those at the bottom of the well in Clay county must have been less than two hundred feet from the Permian.

The line of demarkation between the different geological formations of Kansas are very obscure. A physical unconformability I have never seen, and the division, as shown by a difference of fossils, the best criterion, is also very indistinct. We must consider, also, that the sandstones called Triassic and the Cretaceous in Kansas are so similar in color, hardness, fineness, and chemical elements, that were a hundred tons of each thrown into the door yard of Dana; the great geologist and mineralogist, he could not, from any of the characteristics (aside from fossils) tell to which of the two formations either pile belonged.